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(56) Documents cited
GB 2161784 A GB 1574740 A GB 1364769 A
GB 1138670 A US 4393959 A US 4082197 A

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INT CL[5] B60G 17/005, B66F 9/065

(54) Load handling truck

(57) A front load handling truck such as a fork lift vehicle is of compact size with width and length of approximately 1.7 and 3 metres respectively and has unsuspended front wheels and suspended steerable rear wheels 8 and 9. A single telescopic boom is pivotally mounted at its rear end at the rear of the vehicle and extends to overlie the wheels at one side of the truck to be offset from the fore/aft centre line 3 of the truck and provide space for a drivers cab 2. Fork lift tines are carried at the front end of the boom so that they can be raised and lowered by controlling elevation and/or extension of the boom. To provide stability for the truck during predetermined conditions of use the rear wheels 8 and 9 can be locked to be unsuspended in the truck and thereby convert a triangular system of support which accommodates the load from the boom into a temporary rectangular system of support, the front wheels and axle pivot point 12 defining the triangular system and both front and rear wheels the rectangular system. Preferably, hydraulic cylinders 40 lock the rear wheels either manually or automatically from sensor responding to truck conditions or location.

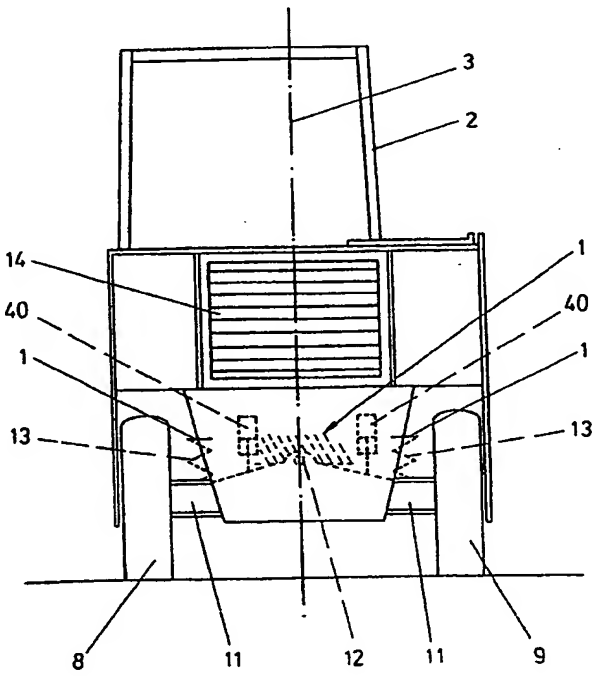

FIG. 3

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

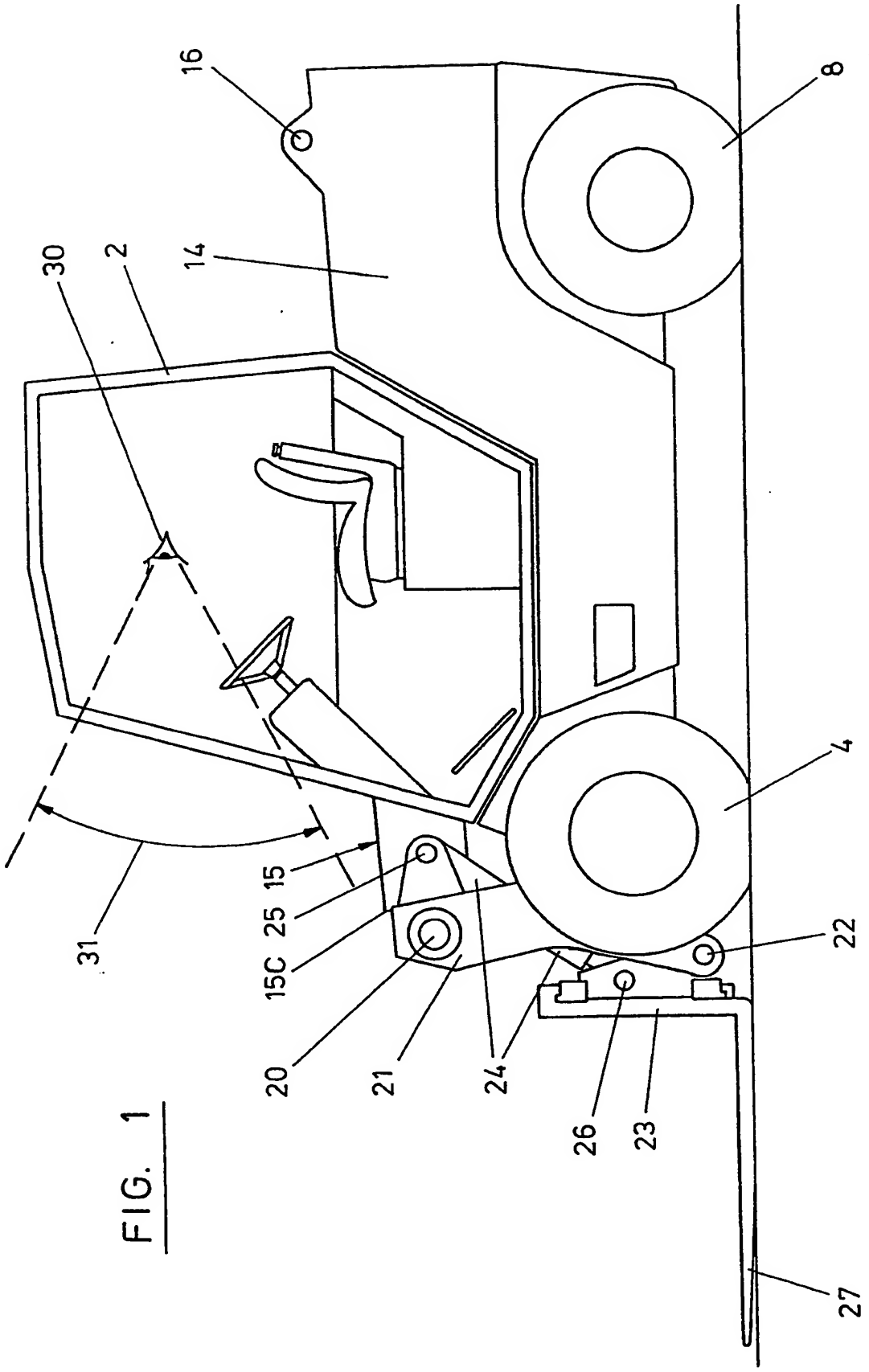

FIG. 1

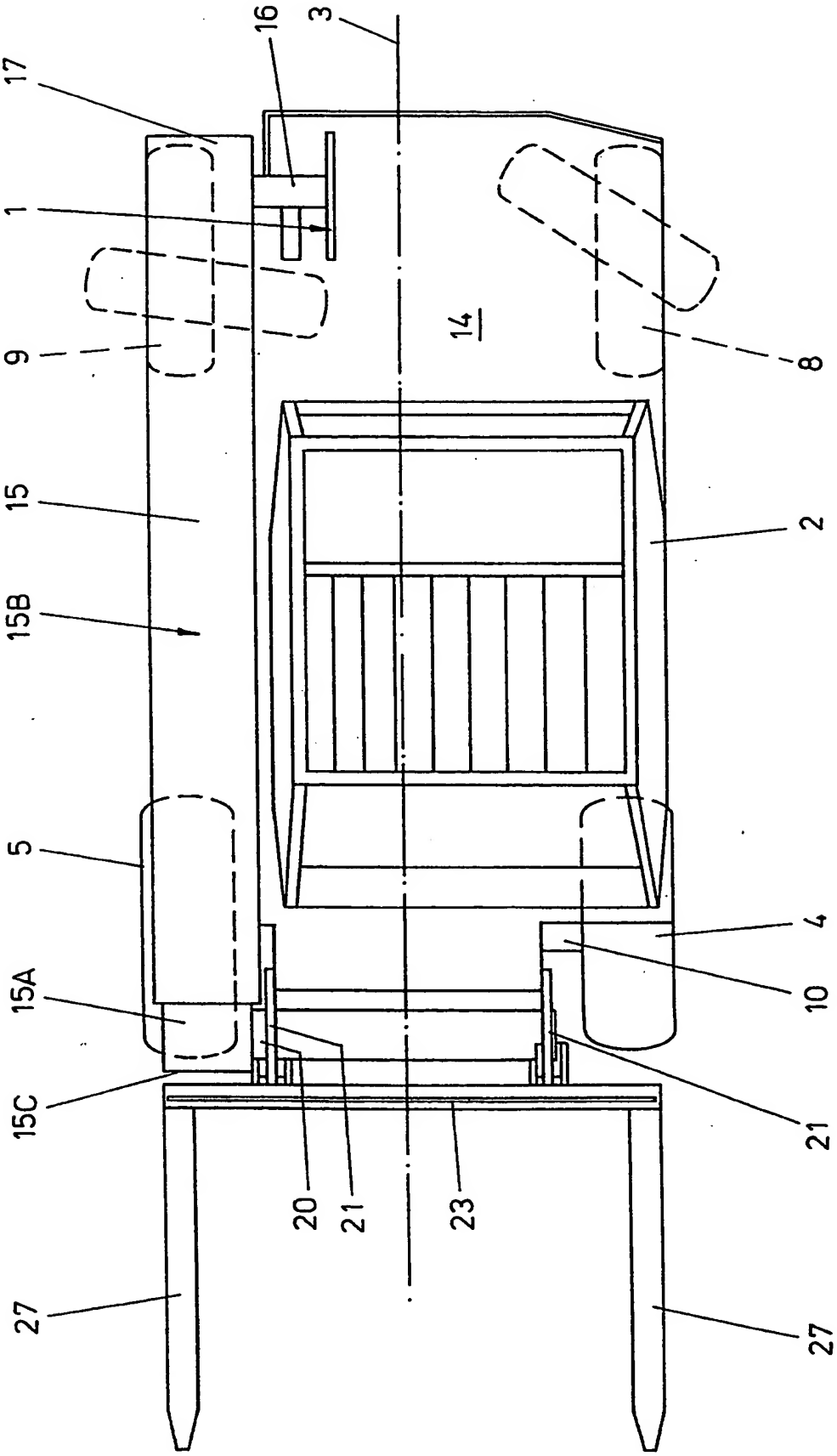

FIG. 2

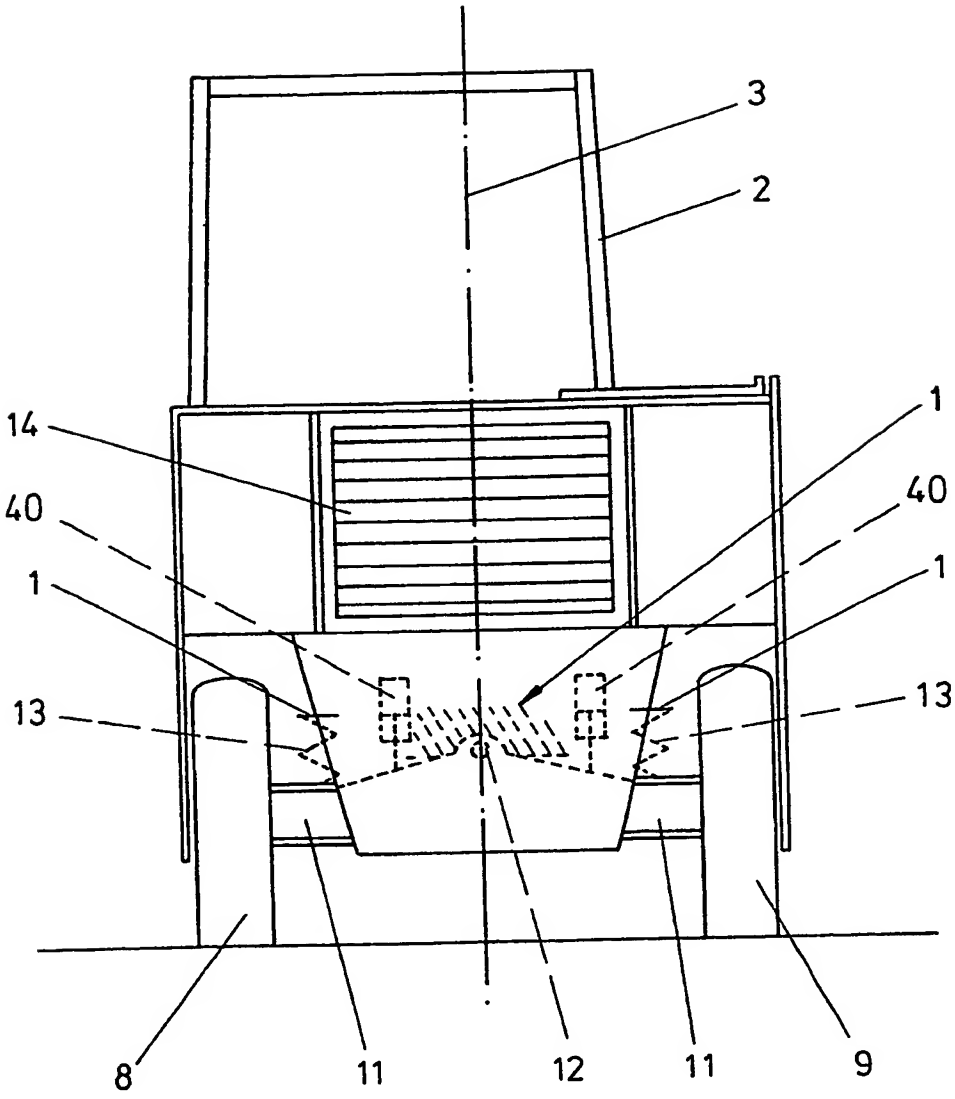

FIG. 3

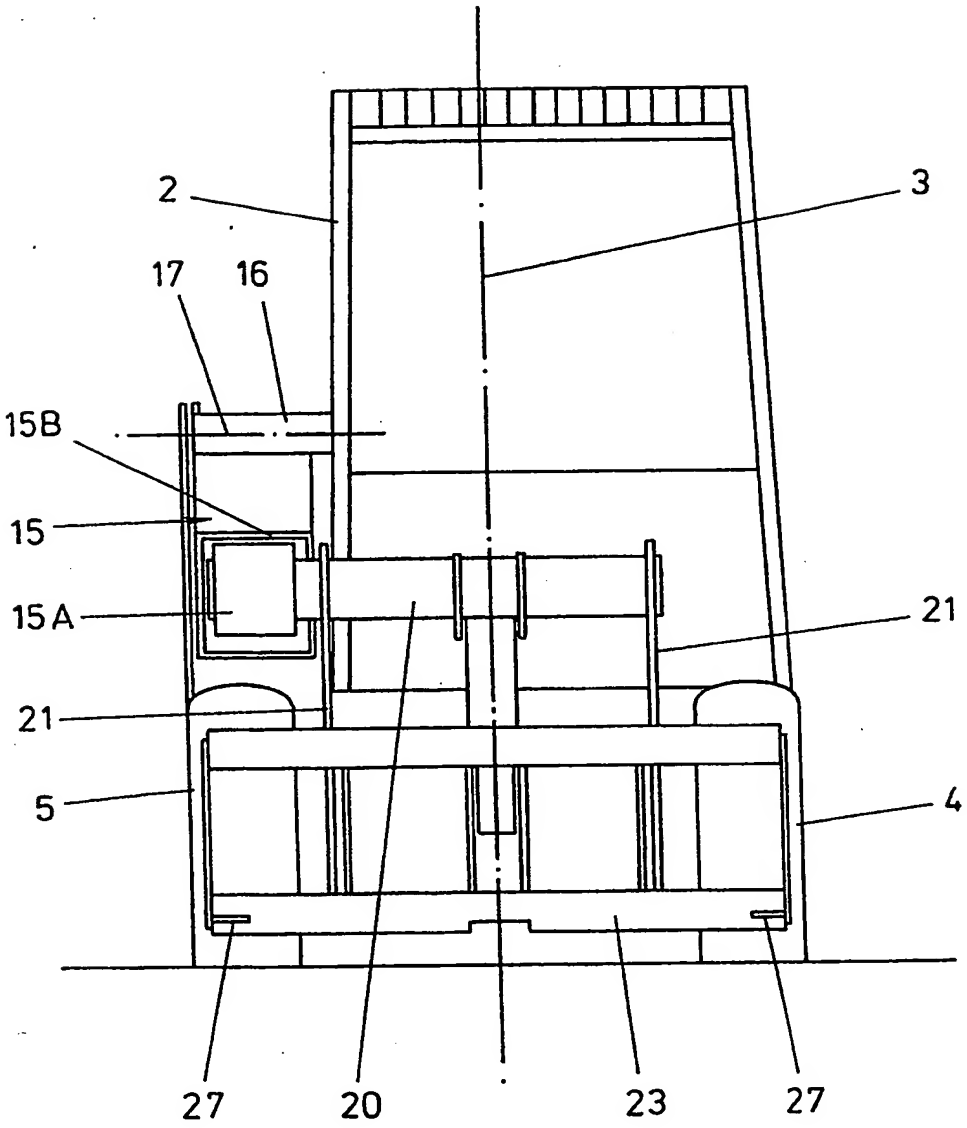

FIG. 4

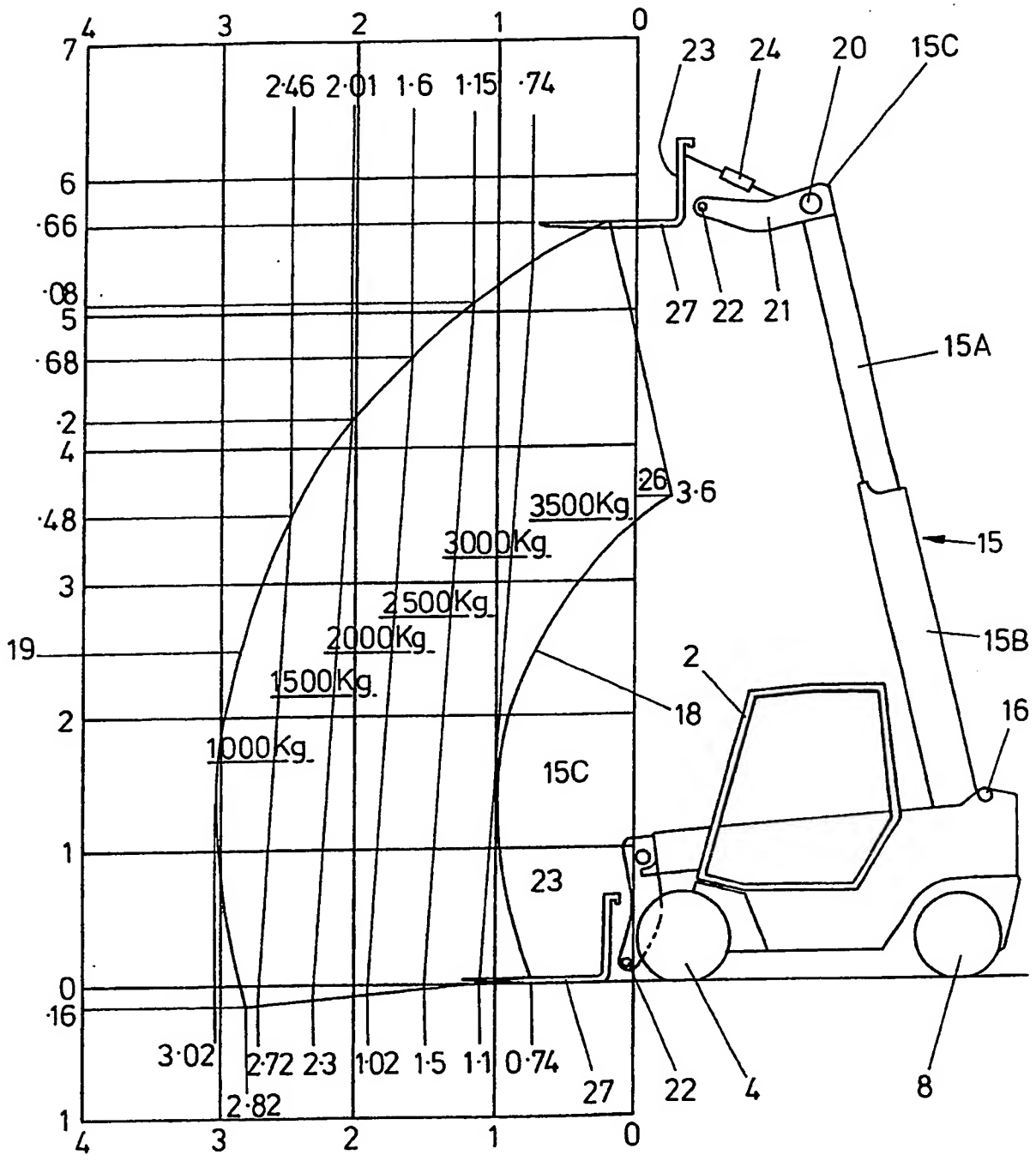
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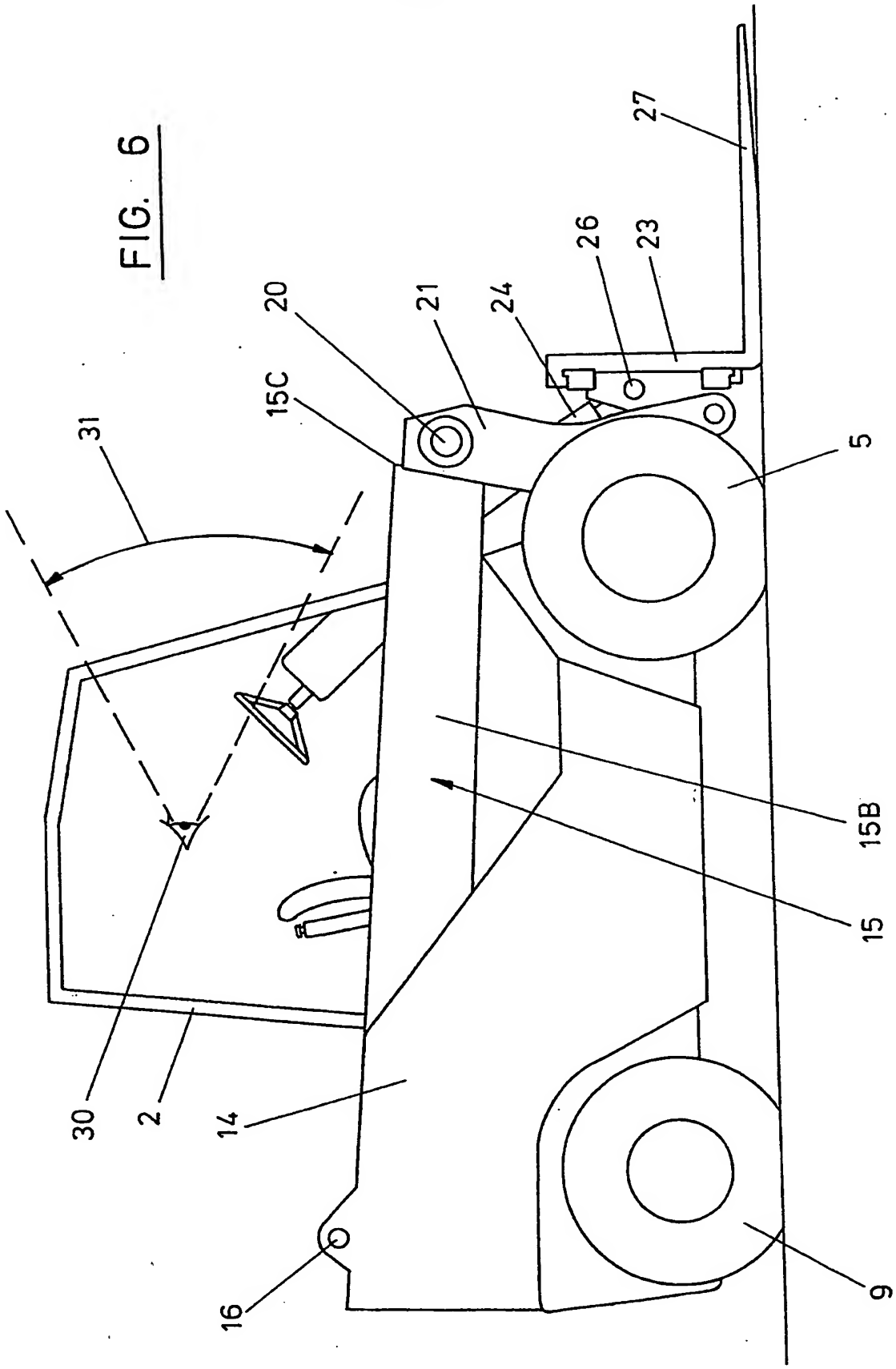
FIG. 5

FIG. 6



TITLE

"A front load handling truck"

TECHNICAL FIELD & BACKGROUND ART

The present invention relates to a front load handling truck such as a fork or platform lift truck and particularly concerns such trucks as are known in the art as being of a compact structure, typically having a width less than 1.7 metres, to be suitable for industrial load handling typically in warehouses where the truck is likely to experience restricted manoeuvring space in relatively narrow aisles, corridors and access openings through which it is to be negotiated.

The primary purpose of compact industrial front load handling trucks is to lift and carry loads on vertically adjustable tines or platforms carried at the front of the trucks. For convenience the present invention will be discussed hereinafter with reference to fork lift trucks but it will be realised that the comments are equally applicable to platform lift trucks. With known fork lift trucks the tines are vertically displaceable over an upstanding frame or mast mounted at the front of the vehicle and in front of the driver. This mast or frame usually extends to a considerable height over which the tines can be displaced and may also comprise two or more sections which can be raised to increase its overall height and therefore the permissible lift height of the tines. With such known compact fork lift trucks the forward visibility of the driver is through the frame or mast structure so that such visibility is necessarily impaired. There is also the disadvantage that the mast or frame structure usually stands at a considerable height which can cause loss of access of the vehicle through doorways in warehouses and the like. This is also true of masts or

frames which are constructed of several sections that can be raised to increase the height over which the forks are vertically adjustable and which sections even when lowered may stand too high to permit access of the truck through a reasonable height doorway of an industrial premises. There is a still further disadvantage that multiple and complex lifting mast or frame sections of varying lengths for each lift height may be required for very high fork lift capabilities with consequential high manufacturing costs. Compact industrial forklift trucks are generally regarded as relatively unsophisticated vehicles which serve a necessary but limited function. It is therefore important that a truck design and structure permits manufacturing costs to be minimised whilst ensuring that the truck is reliable and efficient and particularly that in use it will comply with specified safety standards which are usually laid down by recognised authorities. This latter requirement is especially true of the stability of the fork lift truck during load handling. There is therefore a requirement for a compact industrial load handling (forklift or platform) truck which is capable of relatively inexpensive manufacture, is capable of efficient load handling and lifting, possibly to a considerable height, whilst ensuring that the forward visibility of the truck driver is not unnecessarily impaired by components of the truck, and which will provide stable load handling characteristics within acceptable parameters. It is an object of the present invention to provide a load handling truck which lends itself to satisfying the aforegoing requirement.

STATEMENT OF INVENTION & ADVANTAGES

According to the present invention there is provided a compact front load handling truck having an overall width

less than 1.7 metres and comprising a chassis; a pair of ground engaging front wheels spaced widthwise of the truck to be located one at each side thereof; a pair of ground engaging rear wheels spaced widthwise of the truck to be located one at each side thereof, the wheels in one of said pairs being rotatably mounted substantially rigid with the chassis and the wheels in the other of said pairs being rotatably mounted by a suspension sprung relative to the chassis; the wheels in at least one of said pairs being steerable; a single boom pivotally mounted at a rear end region thereof to the chassis and extending forwardly/aftwardly of the truck, said boom being offset substantially to overlie the front and rear wheels at one side of the truck and to provide clearance widthwise of the truck in which clearance is located a drivers station alongside the boom; said boom having a front end region at which is located a load carrying facility; powered means controlling elevation of the boom by pivotal movement thereof whilst maintaining said overlying relationship with the side wheels to raise and lower the load carrying facility, and locking means to lock the suspension of the wheels in said other pair rigid with the chassis.

The load carrying facility preferably has forwardly extending tines of a fork lift and will, for convenience, hereinafter be discussed as such. Other facilities are possible however such as a forwardly extending horizontal platform.

The compact truck of the present invention preferably has an overall width in the range of 1.4 to 1.5 metres. The truck will likely have a length (excluding the load handling facility) and height (including a drivers cab) in the order of 3 metres and 2.2 metres respectively with a load handling capacity in the order of 3 to 4 tonne. With

these latter characteristics it will be appreciated that the truck will be extremely compact as is desirable for manoeuvring in relatively narrow aisles and passages of industrial complexes. The truck can have drive and power systems which are conventional for compact forklift trucks and appropriate for the required load handling capacity. Although a relatively small width limitation is applied to the truck, because the single boom for the forklift is offset to one side of the truck to overlie the wheels at that side, adequate space can be provided widthwise of the truck within which to comfortably locate a cab at the drivers station (so that during an adjustment in its elevation the boom will raise or lower alongside the drivers cab). Adjacent to and in its lowermost condition of elevation (which will be that usually adopted for general purpose travel), the boom together with the forklift (or other facility) which it carries at its front end can be located well below the horizontal sight line of the truck driver so that the driver's visibility will not be impaired by upstanding frame or mast structures. From the aforegoing it will be appreciated that with the boom lowered the height of the truck will likely be determined by a driver's cab or roll bars on the chassis and if this height is maintained in the order of 2.2 metres it is unlikely that the truck will experience any difficulty in passing beneath door openings which it can reasonably expect to encounter on industrial/warehouse sites.

Preferably the boom is telescopic comprising two or more sections which are telescopically arranged in known manner to be extendible and contractible for adjusting the forward reach and/or the height of the forklift. With such a telescopic boom the forklift height may be several multiples of the truck height whilst the capability is

maintained for the truck to be adjusted into its compact configuration.

It has been inferred that the general attitude adopted by industry to the purchase of forklift trucks dictates that design and manufacturing costs are minimised. It is therefore conventional with forklift trucks and a preference of the present invention that the pair of front wheels are unsuspended and rigid with the chassis while the rear wheels are provided with the sprung suspension (which may be mechanical, hydraulic, pneumatic or controlled electrically) for improved road holding characteristics and driver comfort. Preferably the rear wheels are steerable although either or both the front and rear wheels can be steerable. A particular feature of the present invention is that because the single boom is offset to a maximum extent (to provide adequate space for the drivers station) and overlies the vehicle wheels on one side of the truck, locking means is provided by which the wheel suspension can be locked rigid with the truck chassis so that all four of the truck wheels are then rigid with the chassis. The locking means may be actuated manually or actuated automatically in response to predetermined characteristics encountered during use of the truck. The effect of the locking means being actuated is that a triangulated system of support or stability for the chassis provided by the one pair of rigid wheels and other pair of sprung wheels is converted to a rectangular system of support or stability when all four wheels are rigid with the truck chassis; as a consequence the stability of the truck is increased and a greater moment is required to overturn the truck.

Vehicles have hitherto been proposed, for example sophisticated and large heavy duty off-road load handling vehicles, which have a facility to lock rigid with the

vehicle chassis a ground engaging wheel which normally has a spring suspension. Usually this locking is effected mechanically or hydraulically, typically by use of piston and cylinder devices either where wheels are independently sprung or where several wheels are provided with a spring suspension on a common axle. Similar locking means may be provided for the sprung suspension of the appropriate pair of front or rear wheels in the compact truck of the present invention. The locking means may be actuated automatically to lock the wheel suspension rigid with the chassis in response to a wide variety of predetermined characteristics for the truck or its location when it is considered appropriate for safety purposes to improve the stability of the truck. For example, locking of the wheel suspension may be effected at predetermined elevation angles of the boom and/or extensions of a telescopic boom; at slow truck speeds less than a predetermined speed and at which trucks can reasonably expect to travel when effecting load carrying manoeuvres, and at predetermined angles of tilt for the chassis. Sensors responsive to the changes in the appropriate characteristics and controlling actuation of the locking means automatically will be provided although it will be appreciated that the locking means may be actuated manually, for example in response to visual or audible alarms indicating that increased stability is recommended.

The truck may be driven through either or both the front or rear wheels and the drive to the required wheels can be effected and controlled in a manner conventional for compact industrial fork lift vehicles.

From the aforegoing it will be realised that the truck of the present invention provides a combination of features which is unique in compact industrial forklift or platform

lift truck structures and which combination of features provides considerable advantages in load handling, stability and driver's visibility as compared with conventional compact industrial forklift or platform lift trucks.

DRAWINGS

One embodiment of a forklift truck constructed in accordance with the present invention will now be described, by way of example only, with reference to the accompanying illustrative drawings in which:

Figure 1 is a side elevation of the truck with a telescopic boom which is shown contracted and in its lowermost condition;

Figure 2 is a plan view of the truck;

Figure 3 is a rear view of the truck;

Figure 4 is a front view of the truck;

Figure 5 is an elevation from one side of the truck diagrammatically illustrating the range of reach and elevation available for the fork lift on the telescopic boom,and

Figure 6 is an elevation from the opposite side of the truck.

DETAILED DESCRIPTION OF DRAWINGS

The vehicle illustrated is a compact front fork lift industrial truck having a chassis (shown generally at 1 in Figure 3) carrying a superstructure which comprises a forwardly disposed driver's cab 2 having an open mesh top. The cab 2 has a width less than the overall width of the vehicle and is off-set from a fore/aft centre line 3 (see Figures 2 to 4) of the truck to be located towards one side of the truck. The truck has four ground engaging wheels consisting of a pair of non-steerable and driven front wheels 4 and 5 and a pair of steerable rear wheels 8 and 9.

The front wheels are rotatably mounted on an axle 10 to be rigid (that is without suspension) on the chassis and spaced widthwise to be located one at each side of the truck. The pair of rear wheels 8 and 9 are rotatably and pivotally mounted on an axle 11 (see Figure 3) so that they are spaced widthwise to be located one at each side of the truck and adjustable about their pivot mountings (as indicated by the ghost rear wheels in Figure 2) for steering the truck. The axle 11 forms part of a suspension by which the rear wheels are sprung relative to the chassis 1. In Figure 3 the axle 11 is shown mounted on the chassis 1 by a pivot 12 and has coil spring suspension indicated at 13. It will be appreciated that the aforementioned suspension is shown for convenience only and many alternative forms of suspensions may be used for the rear wheels, for example they may be independently sprung and provided with an hydraulic or active suspension as is well known in the art. As shown in Figure 2 the pair of rear wheels 8 and 9 are in fore/aft alignment one with each of the front wheels 4 and 5. The pair of front wheels 4 and 5 are driven in conventional manner by an engine or electric motor carried by the chassis 1 in an engine compartment 14 behind the cab 2.

The truck has a single telescopic boom 15 which extends in the fore/aft direction of the truck parallel to and off-set from the centre line 3. The boom 15 is located at one side of the truck generally alongside the cab 2 to overlie the front and rear wheels 5 and 9 at that side of the truck. The boom 15 is mounted by a pivot 16 towards its rear end 17 on the chassis 1 towards the rear of the truck. One or more hydraulic rams (not shown) are provided between the boom and the chassis for elevating the boom from its lowermost condition by rotation about the

pivot 16. The boom is formed with two telescopically interconnected box sections (a front section 15A and a rear section 15B having the end 17) which are controlled in known manner to extend or contract the boom length to vary its reach while its angle of elevation may also be varied. In Figure 5 the boom is shown at positions of its maximum extension and elevation (uppermost condition) and its minimum extension and lowermost condition and notional lines 18 and 19 indicate the typical elevational sweep of the front end 15C of the boom when fully retracted (along the line 18) and when fully extended (along the line 19). With the truck standing on a horizontal surface, the elevational sweep of the boom 15 when unloaded is restricted to a substantially vertical plane within which are located the front and rear wheels on the same side of the truck as the boom.

A horizontal cross bar 20 extends rigidly widthwise of the truck from the front end 15C of the boom and a pair of parallel arms 21 extend radially of, and as rigid extensions from, the cross bar 20. In the lowermost condition of the boom the cross bar 20 is located level with the lower region of the cab 2 (see Figure 1) and the arm 21 extends generally downwardly from the cross bar. Mounted by pivots 22 on the free ends of the arms 21 is an upstanding fork lift frame 23 which extends over the major width of the truck. A ram 24 extends between, and is pivotally connected at 25 and 26 respectively to, the cross bar 20 and the fork lift frame 23. Projecting forwardly of the frame 23 and carried thereby (possibly as integral parts of the frame or adjustable on the frame widthwise of the truck) are forklift tines 27. The ram 24 controls pivotal movement of the fork lift frame 23 about the pivot 22 to ensure that the tines 27 are maintained in a

substantially horizontal plane as the elevation of the boom 15 is adjusted (as indicated in Figure 5). Conveniently the ram 24 operates as a slave and in known manner from the rams which control the boom elevation.

In a typical commercial vehicle, the fork lift truck will have an overall body length (excluding the tines 27) of approximately 3 metres, and overall width of approximately 1.5 metres and a height to the top of the cab 2 of approximately 2.2 metres. The tines 27 will usually have a length in the order of 1 metre and with the aforementioned overall dimensions it will be apparent that the truck is of compact size appropriate for use in a typical warehouse or other industrial site to be manoeuvrable in restricted areas such as relatively narrow aisles or corridors whilst being capable of passing beneath average door openings. Typically the cab 2 will have a width of approximately 1.1 metres (which is quite adequate to comfortably accommodate an averagely sized driver) so that there is a widthwise space of approximately 0.4 metres within which to accommodate the box-sectioned boom 15 alongside the cab 2. It will therefore be appreciated that the boom 15 can be of a substantial structure and that adequate spacing is available in the superstructure to accommodate an engine or motor of substantial power and other components such as gearing and controls necessary for both driving the vehicle and actuating the boom. Typically the fork lift truck will have a maximum lifting capacity of approximately 3 to 4 tonnes when the boom is retracted and understandably this lifting capacity will reduce as the boom is extended from, say, a 3 metre fully contracted length to a 6 metre fully extended length. By appropriate control of the length and elevation of the boom 15, the fork lift tines 27 and goods carried thereby can be

moved over a considerable reach from, and height above the truck. Furthermore, for the major part of the range of these manoeuvres the forward visibility of a driver in the cab 2 will not be obstructed by the fork frame 23, legs 21, cross bar 20 or ram 24 and the driver can at all times have good sighting in the position of the fork lift tines 27 and the load which they carry. In particular it will be seen from the driver's eye line shown at 30 in Figure 1 that with the boom contracted and in or adjacent its lowermost condition, the driver will have substantially unobstructed forward vision (as indicated at 31) and similarly good sideways and rear vision is available by having a low level engine compartment 14 and a low boom position.

Safe manoeuvring and handling is essential, within reasonably practical tolerances, for a fork lift truck, particularly when carrying a load. In achieving the aim of providing a compact fork lift truck structure, it has been necessary to locate the boom 15 over the wheels on one side of the vehicle. As a consequence, when the boom is loaded, the suspension for the rear wheels 8 and 9 provides a triangulated system of support for the chassis 1 (that is the triangle formed by the front wheels 4 and 5 and the pivot 12 between the rear axle and the chassis). The rigidity of this triangulated support is therefore related to the characteristics of the suspension springs 13. These springs provide a measure of comfort for the driver during manoeuvring of the truck and can maintain the four wheels on the ground as the truck moves over shallow uneven surfaces. However, as the load on the boom increases the chassis will be subjected to a moment of force causing it to tip about its triangulated support system so that the truck approaches a condition of instability. To alleviate this problem, locking means 40 may be actuated

which causes the rear wheels 8 and 9 to become unsuspended and effectively rigidly mounted with the chassis 1. The effect of this is that the triangulated system of support for the chassis is converted to a rectangular system of support presented by the front and rear pairs of wheels; a greater moment of force is therefore required to cause the truck to lose its stability or overturn as compared with the triangulated system of support. In the present example the aforementioned locking means is shown (see Figure 3) as a pair of rams 40 which interconnect between the chassis and the rear axle 11 and are capable of locking two components together (in the sense of removing the effect of the sprung suspension). It will be appreciated that alternative forms of locking means 40 can be employed such as electrically actuated mechanical locks. The locking means may be actuated manually when considered appropriate by the truck driver although it is preferred that such means is actuated automatically in response to signals initiated by predetermined characteristics of the truck or its location. With this latter feature in mind sensors (not shown) may be located at appropriate positions on the truck to issue signals for the locking means to be actuated in response to, for example, predetermined elevation angles and/or lengths of the telescopic boom, predetermined truck speeds (such as when the truck is at a speed less than a predetermined speed at which the truck can reasonably be expected to travel when effecting manoeuvres carrying a predetermined load), or predetermined angles of inclination of the chassis or angles of tilt between the chassis and the rear axle 11.

Although the above described and illustrated truck has two pairs of ground engaging wheels, it is possible for one or more additional pairs of wheels to be provided with one

wheel of each additional pair located on each side of the vehicle generally in fore/aft alignment with the four wheels shown to increase the load carrying capacity of the truck. The additional wheels may be rotatably mounted either rigid with or suspended from the chassis and in the latter case locking means similar to that shown at 40 may also be provided for the additional wheels. Furthermore, it is possible for each wheel in the pairs of front and rear wheels illustrated to be replaced by a pair of wheels to increase the load bearing capability of the truck.

Stabilizers (not shown) may be carried on the chassis to be temporarily extendible from the chassis into a ground engaging position to improve the truck stability if the fork lift truck is not intended to be manoeuvred during load handling.

CLAIMS

1. A compact front load handling truck having an overall width less than 1.7 metres and comprising a chassis; a pair of ground engaging front wheels spaced widthwise of the truck to be located one at each side thereof; a pair of ground engaging rear wheels spaced widthwise of the truck to be located one at each side thereof, the wheels in one of said pairs being rotatably mounted substantially rigid with the chassis and the wheels in the other of said pair being rotatably mounted by a suspension sprung relative to the chassis; the wheels in at least one of said pairs being steerable; a single boom pivotally mounted at a rear end region thereof to the chassis and extending forwardly/aftwardly of the truck, said boom being offset substantially to overlie the front and rear wheels at one side of the truck and to provide clearance widthwise of the truck in which clearance is located a drivers station alongside the boom; said boom having a front end region at which is located a load carrying facility; powered means controlling elevation of the boom by pivotal movement thereof whilst maintaining said overlying relationship with the side wheels to raise and lower the load carrying facility, and locking means to lock the suspension of the wheels in said other pair rigid with the chassis.

2. A truck as claimed in claim 1 in which the load carrying facility comprises forwardly extending tines of a fork lift.

3. A truck as claimed in either claim 1 or claim 2 in which the overall width is in the range 1.4 to 1.5 metres.

4. A truck as claimed in any one of the preceding claims having a body length (not including the length of the load carrying facility) of substantially 3 metres.

5. A truck as claimed in any one of the preceding claims and comprising a cab at the drivers station, the boom being adjustable in its elevation alongside the cab and in overlying relationship with said side wheels.

6. A truck as claimed in claim 5 having an overall height of substantially 2.2 metres with the boom in a lowermost condition of elevation.

7. A truck as claimed in any one of the preceding claims in which the boom is telescopic and comprises at least two sections which are telescopically arranged to be extendible and contractible for adjusting the forward reach and/or the height of the load handling facility.

8. A truck as claimed in any one of the preceding claims in which the sprung suspension of the wheels in said other pair is mechanically, hydraulically, pneumatically or electrically effected or controlled.

9. A truck as claimed in any one of the preceding claims in which the locking means is actuable manually to lock the wheel suspension.

10. A truck as claimed in any one of the preceding claims in which the locking means is actuated automatically to lock the wheel suspension in response to signals derived from sensors which are responsive to changes in predetermined characteristics of the truck or its location.

11. A truck as claimed in claim 10 in which the locking means is actuated automatically in response to signals provided at least one of a predetermined angle of elevation of the boom, a predetermined extension of a telescopic boom, a predetermined range of speed of the truck and a predetermined angle of tilt experienced by or in the truck.

12. A truck as claimed in any one of the preceding claims in which the rear wheels are mounted by the sprung suspension.

13. A truck as claimed in any one of the preceding claims in which at least the rear wheels are steerable.

14. A front load handling fork lift truck substantially as herein described with reference to the accompanying illustrative drawings.

Patents ct 1977
Examiner's report to the Comptroller under Section 17 (The Search eport)

Application number
9204082.3

Relevant Technical fields

(i UK Cl (Edition K) B8H, HAC, HAJ, HAX, HAU. B7D, DHF

.) Int CL (Edition 5) B66F 9/065 B60G 17/005

Search Examiner
D MCMUNN

atabases (see over)

i) UK Patent Office

ii)

Date of Search
25 JUNE 1992

Documents considered relevant following a search in respect of claims 1-14

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
Y	GB 2161784 (McCONNELL)	1-13
Y	GB 1574740 (COVENTY CLIMOSI)	1-13
Y	GB 1364769 (KOEHRING)	1-13
Y	GB 1138670 (LANDEBORG)	1-13
Y	US 4393959 (ACKER)	1-13
Y	US 4082197 (STODMAN) - see Figure 6	1-13

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

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